

REMARKS

Claims 30, 32, 33, 35, 36, 39-48 and 57 are currently pending in this application. Claims 12-16 and 21-29 have been canceled. Claims 32, 39 and 43 have been amended and new claim 57 has been added. Claim 39 has been amended to recite that the bit lines are positioned "substantially directly" above and below the active area of the magnetic bit cell. Support for this amendment can be found in the disclosure, for example at page 17, lines 23-28 of the disclosure and in Figure 8 and no new matter is believed to have been added by virtue of this amendment.

Claims 32 and 43 are objected to as depending on canceled claim 31. In response, these claims have been amended to depend from claim 30. Based thereon, reconsideration and withdrawal of the objection to claims 32 and 43 is respectfully requested.

Claims 12, 16, and 21-23 stand rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over U.S. Patent No. 6,191,581 to Van Dau (hereinafter "Van Dau") in view of U.S. Patent No. 5,361,226 to Taguchi (hereinafter "Taguchi") and claims 13-15 and 24-29 stand rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Van Dau in view of Taguchi and further in view of U.S. Patent No. 5,721,654 to Manako (hereinafter "Manako").

Claims 12-16 and 21-29 have been canceled and thus the rejection of these claims is now moot.

Claims 30, 32, 33 and 43-48 stand rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Van Dau in view of Manako.

Firstly, the Examiner asserts that Van Dau discloses a magnetic bit cell for use in a planar Hall effect magnetoresistive random access memory device (MRAM). The Examiner acknowledges that Van Dau is silent as to whether the magnetic film is

epitaxially grown on a perovskite single crystal so that easy axes are at a 45-degree angle relative to the direction of the current and uses Manako to cure the deficiencies of Van Dau. The Examiner asserts that Manako describes a magnetic sensor comprising a magnetic film which is epitaxially grown on a single crystal substrate and that it would be obvious to select a perovskite single crystal substrate as that of Manako for the substrate of Van Dau.

Applicants respectfully disagree that the combination of Van Dau and Manako describes or suggests all of the features of the claimed invention.

Applicants respectfully submit that Van Dau does not describe or suggest magnetic bit cells, but only describes magnetic sensors. One of the major differences between magnetic bit cells and magnetic sensors, is that in magnetic bit cells, when the magnetic field is zero, the current is at 45 degrees relative to the magnetization. This feature is highlighted in the claims of the present invention. In contrast, in the planar Hall effect sensor, when the magnetic field is zero, the current is parallel to the magnetization. Therefore, one cannot simply take a planar Hall effect sensor and use it as a memory bit cell. Appellants respectfully submit that, as described and claimed in the present invention, a magnetic memory bit cell is fabricated so that in the two stable states of the magnetization, the angle between the current and the magnetization is 45 degrees and this feature is neither described or suggested by the prior art of record.

Applicants further submit that Van Dau specifically addresses planar Hall effect sensors and there are essential differences, which are highlighted in the claimed invention, between planar Hall effect sensors and planar Hall effect memory. As discussed above, while in both cases there is a cross configuration, in the case of a planar Hall effect sensor (such as the one described in Van Dau), the two easy axes of the magnetization are parallel to the current and voltage leads while in the case of planar Hall effect memory, the easy axes are rotated 45 degrees relative to the current and voltage leads. This is an essential difference which allows the use of planar Hall effect for memory application. Applicants respectfully submit that this difference cannot be

anticipated and has consequences on the way the fabricated device should be aligned relative to the crystal axes of the films.

Furthermore, as defined in Applicants' disclosure (for example, at page 3, lines 27-32) the bit magnetic moment has two stable polarities (states) in the absence of any applied magnetic fields along a magnetic axis, which is known as the "easy axis" and is determined at the time of deposition of the magnetic material and fabrication of the magnetic regions of the magnetic bit cell device. Thus, it can be seen that neither Van Dau nor Manako, alone or in combination, disclose magnetic bit cells in accordance with the present invention.

The Examiner also asserts that Van Dau teaches that the voltage measurement as well as the resistivity are varying in accordance to the angle between the magnetization of the film and the measurement current and concludes that it would be obvious to determine which configuration would be best to ensure maximum sensitivity.

Applicants respectfully disagree. Firstly, the discussion in Van Dau is relevant only to magnetic sensors because in sensors it is desirable to know the way the magnetization change its orientation away from the easy axes with changing magnetic fields and the way it is manifested in the voltage readout. In contrast, in magnetic memory, only the voltage readout of the device when the magnetization resides along the two easy axes is important.

Furthermore, the passage in Van Dau referenced by the Examiner refers to a sensor as described in U.S. Patent No. 4,987,509, which is a system comprising two magnetoresistive elements placed so as to be parallel to each other and a conductor placed between these two element in order to induce a polarization field and to determine, when not in use, a direct of the magnetization in each element. As recited in Van Dau, such a sensor relies on the transverse measurement of the anisotropic magnetoresistive effect in a thin ferromagnetic film. Thus, the passage in Van Dau that relates to varying the angle between the magnetization of the film and the measurement

current is only for a magnetic sensor having two magnetoresistive elements placed so as to be parallel to each other, not to a system comprising a magnetic bit cell having all of the features of the present invention.

In fact, the magnetic sensor (as opposed to the magnetic bit cell of the present invention) described in Van Dau recites two easy axes of magnetization oriented along directions of perpendicular axes XX' and YY' (see e.g., col. 3, lines 39-46), which, as discussed above, is different from the presently claimed invention in which the angle between the current and magnetization is 45 degrees. Similarly, the magnetic sensor of Manako also only recites two axes of magnetization oriented along directions of perpendicular axes (see e.g., col. 6, lines 14-21).

For these reasons, Applicants respectfully submit that it is not shown that Van Dau, alone or in combination with Manako, describes or suggests a magnetic bit cell having all of the features of the claimed invention. Based thereon, reconsideration and withdrawal of the rejection of claims 30, 32, 33, and 43-48 as being unpatentable over Van Dau in view of Manako is respectfully requested.

Claims 35, 36, and 39-42 stand rejected as being unpatentable over Van Dau in view of Manako and further in view of Taguchi.

Because claims 30, 32 and 33 and 43-48 are believed to be allowable over the prior art of record for the reasons provided above, claims 35, 36 and 39-42 which depend directly or indirectly from these claims are also believed to be allowable over the prior art of record and notice to that effect is earnestly solicited.

Furthermore, Taguchi discusses memory devices that are based on the extraordinary Hall effect (EHE). However, even though "Hall" is used to describe both effects, there is no connection between planar Hall effect and extraordinary Hall effect and therefore the memory bit is completely different. While the planar Hall effect arises when the magnetization changes its orientation in the film plane, the extraordinary Hall

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effect is sensitive to the component of the magnetization which is perpendicular to the film plane and the two memory states correspond to flipping the magnetization by 180 degrees (upward to downward or vice versa), in the present invention the magnetization is flipped by 90 degrees in the film plane. Therefore, the design is completely different and Taguchi, alone or in combination with Van Dau and or Manako cannot anticipate or render obvious the claimed invention.


Finally, new claim 57 has been added to recite that the sign of the voltage indicates along which of the two easy axes the magnetization in the bit cell resides. This feature was previously set forth in canceled claim 50 and is also believed to distinguish over the prior art of record.

CONCLUSION

Applicants believe that the foregoing is a full and complete response to the Office Action of record. Accordingly, an early and favorable reconsideration of the rejection of the claims is requested. Applicants believe that claims 30, 32, 33, 35, 36, 39-48 and 57 are now in condition for allowance and an indication of allowability and an early Notice of Allowance of all of the claims is respectfully requested.

If the Examiner feels that a telephonic interview would be helpful, he is requested to call the undersigned at (203) 575-2648 prior to issuance of the next Office action.

Respectfully submitted,



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